

FORM PTO-1390 (REV. 12-2001)		U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE		ATTORNEY'S DOCKET NUMBER  <b>BSW-1</b>	
<b>TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371</b>				U.S. APPLICATION NO. (If known, see 37 CFR 1.5) <div style="font-size: 1.5em; font-weight: bold;">10/031182</div>	
INTERNATIONAL APPLICATION NO. <b>PCT/NZ00/00127</b>		INTERNATIONAL FILING DATE <b>17 July 2000</b>		PRIORITY DATE CLAIMED <b>16 July 1999</b>	
TITLE OF INVENTION <b>PHOTO-LUMINESCENT PIGMENT APPLICATION</b>					
APPLICANT(S) FOR DO/EO/US <b>George Trevor DIMOND et al.</b>					
Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information.					
<ol style="list-style-type: none"> <li>1. <input checked="" type="checkbox"/> This is a <b>FIRST</b> submission of items concerning a filing under 35 U.S.C. 371.</li> <li>2. <input type="checkbox"/> This is a <b>SECOND</b> or <b>SUBSEQUENT</b> submission of items concerning a filing under 35 U.S.C. 371.</li> <li>3. <input type="checkbox"/> This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.</li> <li>4. <input checked="" type="checkbox"/> The US has been elected by the expiration of 19 months from the priority date (Article 31).</li> <li>5. <input checked="" type="checkbox"/> A copy of the International Application as filed (35 U.S.C. 371(c)(2))           <ol style="list-style-type: none"> <li>a. <input type="checkbox"/> is attached hereto (required only if not communicated by the International Bureau).</li> <li>b. <input checked="" type="checkbox"/> has been communicated by the International Bureau.</li> <li>c. <input type="checkbox"/> is not required, as the application was filed in the United States Receiving Office (RO/US).</li> </ol> </li> <li>6. <input type="checkbox"/> An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).           <ol style="list-style-type: none"> <li>a. <input type="checkbox"/> is attached hereto.</li> <li>b. <input type="checkbox"/> has been previously submitted under 35 U.S.C. 154(d)(4).</li> </ol> </li> <li>7. <input checked="" type="checkbox"/> Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))           <ol style="list-style-type: none"> <li>a. <input type="checkbox"/> are attached hereto (required only if not communicated by the International Bureau).</li> <li>b. <input type="checkbox"/> have been communicated by the International Bureau.</li> <li>c. <input type="checkbox"/> have not been made, however, the time limit for making such amendments has NOT expired.</li> <li>d. <input checked="" type="checkbox"/> have not been made and will not be made.</li> </ol> </li> <li>8. <input type="checkbox"/> An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).</li> <li>9. <input checked="" type="checkbox"/> An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).</li> <li>10. <input type="checkbox"/> An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).</li> </ol>					
<b>Items 11 to 20 below concern document(s) or information included:</b>					
<ol style="list-style-type: none"> <li>11. <input checked="" type="checkbox"/> An Information Disclosure Statement under 37 CFR 1.97 and 1.98.</li> <li>12. <input type="checkbox"/> An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.</li> <li>13. <input checked="" type="checkbox"/> A <b>FIRST</b> preliminary amendment.</li> <li>14. <input type="checkbox"/> A <b>SECOND</b> or <b>SUBSEQUENT</b> preliminary amendment.</li> <li>15. <input checked="" type="checkbox"/> A substitute specification.</li> <li>16. <input type="checkbox"/> A change of power of attorney and/or address letter.</li> <li>17. <input type="checkbox"/> A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.</li> <li>18. <input type="checkbox"/> A second copy of the published international application under 35 U.S.C. 154(d)(4).</li> <li>19. <input type="checkbox"/> A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).</li> <li>20. <input type="checkbox"/> Other items or information:</li> </ol>					

U.S. APPLICATION NO. <b>10/031182</b> <small>(known as 37 CFR 1.53)</small>		INTERNATIONAL APPLICATION NO. <b>PCT/NZ00/00127</b>		ATTORNEY'S DOCKET NUMBER <b>BSW-1</b>	
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21. <input checked="" type="checkbox"/> The following fees are submitted: <b>BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)):</b> Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO. .... <b>\$1040.00</b>  International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO ..... <b>\$890.00</b>  International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO ..... <b>\$740.00</b>  International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) ..... <b>\$710.00</b> International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) ..... <b>\$100.00</b> <b>ENTER APPROPRIATE BASIC FEE AMOUNT =</b>				<b>CALCULATIONS PTO USE ONLY</b>	
				\$1040.00	
Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				\$ --00--	
CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	29 - 20 =	9	x \$18.00	\$ 162.00	
Independent claims	2 - 3 =	0	x \$84.00	\$ --00--	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)				+ \$280.00	
<b>TOTAL OF ABOVE CALCULATIONS =</b>				<b>\$1202.00</b>	
<input checked="" type="checkbox"/> Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above are reduced by 1/2.				+ \$ 601.00	
<b>SUBTOTAL =</b>				<b>\$ 601.00</b>	
Processing fee of \$130.00 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				\$ --00--	
<b>TOTAL NATIONAL FEE =</b>				<b>\$ 601.00</b>	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property +				\$ --00--	
<b>TOTAL FEES ENCLOSED =</b>				<b>\$ 601.00</b>	
				Amount to be refunded:	\$
				charged:	\$

a. ☒ A check in the amount of \$ 601.00 to cover the above fees is enclosed. Check No. 5832

b. ☐ Please charge my Deposit Account No. \_\_\_\_\_ in the amount of \$ \_\_\_\_\_ to cover the above fees.  
 A duplicate copy of this sheet is enclosed.


c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any  
 overpayment to Deposit Account No. 501157. A duplicate copy of this sheet is enclosed.

d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card  
 information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

**NOTE:** Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR  
 1.137 (a) or (b)) must be filed and granted to restore the application to pending status.

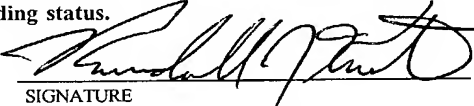
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SIGNATURE

**Randall J. Knuth**

NAME

**34,644**

REGISTRATION NUMBER

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re of Applicant )  
DIMOND et al. ) Art Group:  
Serial No.: )  
Filing Date: January 15, 2002 )  
Title: PHOTO-LUMINESCENT PIGMENT ) Examiner:  
APPLICATION )

PRELIMINARY AMENDMENT

Hon. Commissioner of Patents  
Washington, D.C. 20231

Sir:


Applicant hereby submits the following Preliminary Amendment.

REMARKS

The undersigned respectfully submits that with this Preliminary Amendment no new matter has been added.

If the Examiner has any questions or comments that would speed prosecution of this case, the Examiner is invited to call the undersigned at 260/485-6001.

Respectfully submitted,

  
Randall J. Knuth  
Registration No. 34,644

RJK/jrw

Encs: Replacement Claims  
Marked-up Claims  
Return Postcard

RANDALL J. KNUTH, P.C.  
3510-A Stellohorn Road  
Fort Wayne, IN 46815-4631  
Telephone: 260/485-6001  
Facsimile: 260/486-2794

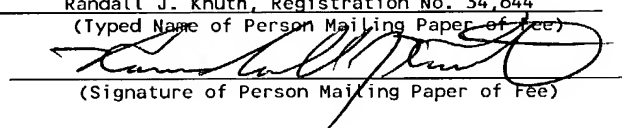
EXPRESS MAIL MAILING NUMBER EL161759954US

Date of Deposit: January 16, 2002.

I hereby certify that this paper or fee is being deposited with the United States Postal Service EXPRESS MAIL POST OFFICE TO ADDRESSEE service under 37 CFR 1.10 on the date indicated above and is addressed to the Commissioner of Patents and Trademarks, Washington, D.C. 20231.

Randall J. Knuth, Registration No. 34,644

(Typed Name of Person Mailing Paper of Fee)

  
(Signature of Person Mailing Paper of Fee)

REPLACEMENT CLAIMS

*Please amend Claim 2 as follows:*

2. A method as claimed in Claim 1 wherein the substrate surface has one of a depression or channel adapted to receive the dry powder formulation.

*Please amend Claim 4 as follows:*

4. A method as claimed in Claim 1 wherein the volume ratio of photo-luminescent pigment to carrier/fixer in the dry powder formulation is such that the fused material exhibits substantially the same strength and durability properties of the carrier/fixer while still exhibiting the photo-luminescent properties of the pigment.

*Please amend Claim 5 as follows:*

5. A method as claimed in Claim 4 wherein the volume ratio is substantially in the range of 1% to 35% of photo-luminescent pigment to carrier/fixer.

*Please amend Claim 6 as follows:*

6. A method as claimed in Claim 1 wherein the dry powered formulation is heated to a temperature recommended by the manufacturer of the carrier/fixer until the formulation is molten.

REPLACEMENT CLAIMS

*Please amend Claim 8 as follows:*

8. A method as claimed in Claim 6 wherein the formulation is heated for approximately 10 to 20 minutes.

*Please amend Claim 9 as follows:*

9. A method as claimed in Claim 1 wherein after heating the formulation is cooled.

*Please amend Claim 10 as follows:*

10. A method as claimed in Claim 1 wherein the carrier/fixer is a heat curable polymer.

*Please amend Claim 11 as follows:*

11. A method as claimed in Claim 1 wherein the dry powder formulation includes small quantities of additives to ensure a smooth surface finish.

*Please amend Claim 12 as follows:*

12. A method as claimed in Claim 1 wherein the substrate is one of stamped, extruded and milled metal.

*Please amend Claim 13 as follows:*

13. An apparatus for applying photo-luminescent pigment to a substrate having a surface, said apparatus including:

a hopper adapted to contain a dry powder formulation, said hopper having at least one orifice adapted to allow transfer of

REPLACEMENT CLAIMS

5 the dry powder formulation from the hopper to a substrate  
surface; and

a guide rail system for locating the substrate surface in  
both a fixed horizontal plane and a fixed vertical plane below  
the hopper and orifice; and a heat-curing system for providing  
10 enough heat to turn the dry powder formulation into a molten  
mixture.

***Please amend Claim 14 as follows:***

14. An apparatus as claimed in Claim 13 which also includes  
a cooling system to cool the molten mixture.

***Please amend Claim 15 as follows:***

15. An apparatus as claimed in Claim 13 which includes a  
drive system to move the substrate through the apparatus.

***Please amend Claim 16 as follows:***

16. An apparatus as claimed in Claim 13 which includes a  
support roller is mounted directly beneath said orifice and said  
hopper to support the substrate.

***Please amend Claim 17 as follows:***

17. An apparatus as claimed in Claim 13 which includes an  
adjustable mounting bracket adapted to enable the hopper to be  
located in the correct position so that said orifice aligns with  
the substrate.

REPLACEMENT CLAIMS

*Please amend Claim 18 as follows:*

18. An apparatus as claimed in Claim 13 wherein said orifice is adapted to communicate snugly with the substrate surface such that the dry powder formulation is deposited substantially only where required.

*Please amend Claim 19 as follows:*

19. An apparatus as claimed in Claim 13 which includes a mechanism for tapping the hopper so that any voids in the dry powder formulation are re-filled.

*Please delete Claim 20 without prejudice.*

*Please amend Claim 21 as follows:*

21. An apparatus as claimed in Claim 13 wherein the heat-curing system is an oven.

*Please amend Claim 22 as follows:*

22. An apparatus as claimed in Claim 13 wherein the heat-curing system is a continuous oven process.

*Please amend Claim 23 as follows:*

23. An apparatus as claimed in Claim 21 wherein the oven includes infra-red heating elements.

REPLACEMENT CLAIMS

*Please amend Claim 24 as follows:*

24. An apparatus as claimed in Claim 13 which includes an automatic loading means and automatic unloading means at each respective end of said guide rail system.

*Please delete Claims 25 and 26 without prejudice.*

*Please amend Claim 27 as follows:*

27. A substrate bearing photo luminescent material when prepared using a method according to Claim 1.

*Please amend Claim 28 as follows:*

28. A substrate bearing photo luminescent material when prepared using an apparatus according to Claim 13.

*Please amend Claim 29 as follows:*

29. A step nosing bearing photo luminescent material prepared using a method according to Claim 1.

*Please amend Claim 30 as follows:*

30. A step nosing bearing photo luminescent material prepared using an apparatus according to Claim 13.

*Please amend Claim 31 as follows:*

31. A handrail bearing photo luminescent material prepared using a method according to Claim 1.



REPLACEMENT CLAIMS

*Please amend Claim 32 as follows:*

32. A handrail bearing photo luminescent material prepared using an apparatus according to Claim 13.

## MARKED-UP CLAIMS

WHAT IS CLAIMED IS:

1. A method of applying photo-luminescent pigment to a substrate, said method including:

preparing a dry powder formulation comprising, at least, a photo-luminescent pigment and a carrier/fixer;

5 depositing the dry powder formulation onto a substrate surface; and

heating the dry powder formulation to fuse it to the substrate surface.

2. A method as claimed in [any preceding claim] Claim 1 wherein the substrate surface has one of a depression or channel [depressions or channels] adapted to receive the dry powder formulation.

3. A method as claimed in Claim 2 which further includes applying a light reflecting layer to the substrate surface before depositing the dry powder formulation.

4. A method as claimed in [any one of claims 1 to 3] Claim 1 wherein the volume ratio of photo-luminescent pigment to carrier/fixer in the dry powder formulation is such that the fused material exhibits substantially the same strength and durability properties of the carrier/fixer while still exhibiting the photo-luminescent properties of the pigment.

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## MARKED-UP CLAIMS

5. A method as claimed in Claim 4 wherein the volume ratio is substantially in the range of 1% to 35% of photo-luminescent pigment to carrier/fixer.

6. A method as claimed in [any preceding claim] Claim 1 wherein the dry powered formulation is heated to a temperature recommended by the manufacturer of the carrier/fixer until the formulation is molten.

7. A method as claimed in Claim 6 wherein the formulation is heated to substantially between 160 to 210 degrees centigrade.

8. A method as claimed in Claim 6 [or claim 7] wherein the formulation is heated for approximately 10 to 20 minutes.

9. A method as claimed in [any preceding claim] Claim 1 wherein after heating the formulation is cooled.

10. A method as claimed in [any preceding claim] Claim 1 wherein the carrier/fixer is a heat curable polymer.

11. A method as claimed in [any preceding claim] Claim 1 wherein the dry powder formulation includes small quantities of additives[, such as a de-gassing additive,] to ensure a smooth surface finish.

12. A method as claimed in [any preceding claim] Claim 1 wherein the substrate is one of stamped, extruded [or] and milled [aluminum or] metal.

## MARKED-UP CLAIMS

13. An apparatus for applying photo-luminescent pigment to a substrate having a surface, said apparatus including:

a hopper adapted to contain a dry powder formulation[;] said hopper having at least one [or more orifices] orifice  
adapted to allow transfer of the dry powder formulation from the hopper to a substrate surface; and

a guide rail system for locating the substrate surface in both a fixed horizontal plane and a fixed vertical plane below the hopper and orifice; and a heat-curing system for providing enough heat to turn the dry powder formulation into a molten [mix] mixture.

14. An apparatus as claimed in Claim 13 which also includes a cooling system to cool the molten [mix] mixture.

15. An apparatus as claimed in [any one of claims 13 to 15] Claim 13 which [also] includes a drive system to move the substrate through the apparatus.

16. An apparatus as claimed in [any one of claims 13 to 15] Claim 13 which includes a support roller is mounted directly beneath [the] said orifice [orifice(s)] and said hopper to support the substrate.

17. An apparatus as claimed in [any one of claims 13 to 17] Claim 13 which includes an adjustable mounting bracket adapted to

## MARKED-UP CLAIMS

enable the hopper to be located in the correct position so that [the orifice(s) lines up] said orifice aligns with the substrate.

18. An apparatus as claimed in [any one of claims 13 to 17] Claim 13 wherein said orifice is adapted to communicate snugly with the substrate surface such that the dry powder formulation is deposited substantially only where required.

19. An apparatus as claimed in [any one of claims 13 to 18] Claim 13 which includes a mechanism for tapping the hopper so that any [rat-holes] voids in the dry powder formulation are re-filled.

***Please delete Claim 20 without prejudice.***

21. An apparatus as claimed in [any one of claims 13 to 20] Claim 13 wherein the heat-curing system is an oven.

22. An apparatus as claimed in [any one of claims 13 to 21] Claim 13 wherein the heat-curing system is a continuous oven process.

23. An apparatus as claimed in Claim [22] 21 wherein the oven includes infra-red heating elements.

24. An apparatus as claimed in [any one of claims 13 to 23] Claim 13 which includes an automatic loading means and automatic unloading means at each respective end of said guide rail system.

***Please delete Claims 25 and 26 without prejudice.***

## MARKED-UP CLAIMS

27. A substrate bearing photo luminescent material when prepared using a method according to [any one of claims 1 to 12 and 25] Claim 1.

28. A substrate bearing photo luminescent material when prepared using an apparatus according to [any one of claims 13 to 24 and 26] Claim 13.

29. A step nosing[, or insert strip for a step nosing,] bearing photo luminescent material [when] prepared using a method according to [any one of claims 1 to 12 and 25] Claim 1.

30. A step nosing[, or insert strip for a step nosing,] bearing photo luminescent material [when] prepared using an apparatus according to [any one of claims 13 to 24 and 26] Claim 13.

31. A handrail[, or insert strip for a handrail,] bearing photo luminescent material [when] prepared using a method according to [any one of claim 1 to 12 and 25] Claim 1.

32. A handrail[, or insert strip for a handrail,] bearing photo luminescent material [when] prepared using an apparatus according to [any one of claims 13 to 24 and 26] Claim 13.

PTD/PCT Rec'd 16 JAN 2002

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complexity and cost of the installation but also provides for additional modes of failure.

It is known to apply a photo-luminescent pigment to a rope, tape or fabric. This  
5 photo-luminescent pigment is stimulated by visible light and remains luminescent for a considerable period after the light source is removed. The problem with tape or fabric impregnated with pigment is that lacks durability for heavy wear areas such as walkways or stairs.

10 Photo-luminescent pigment has been sprayed onto more durable substrate surfaces such as aluminium or metal strips or extrusions. Once the spray has dried, it is ground to provide a smooth finished surface. This overcomes the abovementioned problems associated with heavy wear areas, but considerable pigment is wasted during the spraying and grinding process.

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Accordingly it is an object of the present invention to provide a method and apparatus for applying photo-luminescence pigment to a substrate which avoids or overcomes some of the abovementioned disadvantages, or which at least provides the public with a useful choice.



# Summary of the invention

According to a first aspect of the invention there is provided a method of applying photo-luminescent pigment to a substrate, said method including:

- 5       preparing a dry powder formulation comprising, at least, a photo-luminescent pigment and a carrier/fixer;
- depositing the dry powder formulation onto a substrate surface;
- heating the dry powder formulation to fuse it to the substrate surface.

- 10    Preferably the substrate surface has depressions or channels adapted to receive the dry powder formulation.

Preferably a light reflecting layer is applied to the substrate surface before depositing the dry powder formulation.

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- Preferably the volume ratio of photo-luminescent pigment to carrier/fixer in the dry powder formulation is such that the fused material exhibits substantially the same strength and durability properties of the carrier/fixer, while still exhibiting the photo-luminescent properties of the pigment. More preferably the volume ratio is
- 20    substantially in the range of 1% to 35% photo-luminescent pigment to carrier/fixer.

Preferably the dry powered formulation may be heated to between, substantially, 160 to 210 degrees centigrade, or to a temperature recommended by the manufacturer of

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the carrier/fixer, for approximately 10 to 20 minutes or until the formulation is molten. The molten formulation may be cooled after heating.

Preferably the carrier/fixer is a heat curable polymer.

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Preferably the dry powder formulation may include small quantities of additives, such as a de-gassing additive, to ensure a smooth surface finish.

Preferably the substrate is stamped, extruded or milled aluminium or metal.

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According to a second aspect of the invention there is provided an apparatus for applying photo-luminescent pigment to a substrate, said apparatus including:

a hopper adapted to contain a dry powder formulation;

one or more orifices adapted to allow transfer of the dry powder formulation from the hopper to a substrate surface;

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a guide rail system for locating the substrate surface in both a fixed horizontal plane and a fixed vertical plane below the hopper and orifice; and

a heat-curing system for providing enough heat to turn the dry powder formulation into a molten mix.

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Preferably the apparatus also includes a cooling system to cool the molten mix.

Preferably the apparatus also includes a drive system to move the substrate through the apparatus.

Preferably the apparatus includes a support roller mounted directly beneath the  
5 orifice(s) and hopper to support the substrate.

Preferably the apparatus includes an adjustable mounting bracket adapted to enable the hopper to be located in the correct position so that the orifice(s) lines up with the substrate.

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Preferably the orifice is adapted to communicate snugly with the substrate surface such that the dry powder formulation is deposited substantially only where required.

Preferably the apparatus includes a mechanism for tapping the hopper so that any  
15 rat-holes in the dry powder formulation are re-filled.

Preferably the apparatus includes a brush mounted below the roller, and with its bristles in contact with the roller, so that any powder that falls onto the roller is subsequently brushed off.

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The heat-curing system may be an oven. Optionally, the heat-curing system may be a continuous oven process, and in one embodiment may include infra-red heating elements.

20 The invention provides for a method and apparatus for applying photo luminescent pigment, which is stimulated by UV and visible light and will remain illuminated for a period after the light source is removed, to a substrate such as aluminium or metal strips. The resulting substrate can be used to provide floor, stair or other courtesy or emergency lighting in public areas.

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The process involves filling depressions or channels in a substrate material (typically, but not exclusively, an aluminium extrusion or stamped or milled sheet of aluminium) with a dry powder formulation that contains a photo luminescent pigment; a  
5 carrier/fixer (typically a heat curable polymer); and preferably small quantities of additives (such as a flow additive and/or de-gassing additive) that improve the melt properties of the mix and ensure a smooth surface finish. Sufficient heat is applied to the combined formulation to melt and cure it, and when cooled it fuses to itself and to the substrate.

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In order to improve the effectiveness of the photo-luminescent formulation a light reflective layer can be applied to the substrate before depositing the formulation.

The depressions or channels in the substrate are filled up with the dry powder  
15 formulation to be level with the top surface of the substrate material. When the formulation becomes molten the air between the particles is expelled and the subsequently fused material forms a thick film that smoothly covers both the horizontal and vertical surfaces of the depressions or channels in the substrate. Because the surface of the fused formulation is lower than the highest point of the  
20 depressions or channels it is protected from wear and is suited to use in floor illumination situations.

While a number of products suitable for such a photo-luminescent formulation may be apparent to a skilled addressee, the products used in the current invention are

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LUMINOVA, a photo-luminescent pigment from Nemoto Japan; and TPE, a carrier/fixer produced by Dulux New Zealand. The flow and de-gassing additives are also produced by Dulux New Zealand.

- 5 The ratio of photo-luminescent pigment to carrier/fixer in the dry powder formulation is dependent on the intensity and duration of illumination desired. If greater intensity and duration of illumination is desired, more pigment is added. A typical formulation will contain between 30% and 60% photo luminescent pigment powder by weight. However, because the specific gravity of the powder is typically 3-4 times greater  
10 than the rest of the dry powder formulation, the photo luminescent pigment volume ratio is typically in the range 10% to 30%.

Because the photo-luminescent pigment makes up a relatively small part of the total volume of the fused material the fused material exhibits substantially the same  
15 strength and durability properties that the carrier/fixer would have without the inclusion of the photo luminescent pigment, but it also has the added property of being photo-luminescent. Success has been achieved with volume ratios between 1% and 35% photo-luminescent pigment.

- 20 The principle of the process is to pass the substrate material, with the channels or depressions facing upwards, below a hopper which is filled with the dry powder formulation. The hopper has one or more bottom orifices which is shaped so that the dry powder formulation will fall under its own weight into the channels or depressions and will not spill on either side of the substrate. As the substrate passes

under the hopper the lower surface of the bottom orifice(s) wipe the top surface of the substrate material clean so that the only dry powder formulation that is removed from the hopper is that which fills the channels or depressions. The channels or depressions are filled to be level with the top surface of the substrate. Heat is then applied to cure the dry powder formulation. After heating the formulation may be cooled.

Individual pieces of the substrate material are successively passed underneath the hopper in such a way that no substantial quantities of the dry powder formulation fall between the tail end of one piece and the lead edge of the subsequent piece.

Figures 1 and 2 illustrate, in detail, the hopper section 10 of an apparatus for applying photo luminescent material to a substrate. Figure 3 illustrates a schematic overview (not to scale) of the whole apparatus, each aspect of which will now be described.

The apparatus includes a guide rail system 8 for locating the individual substrate pieces, in this case aluminium extrusion 1, in both a fixed horizontal plane and a fixed vertical plane.

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A drive system is used to push individual substrate pieces passed (below) a hopper 2. This drive system may be a human operator, or it may be a system of motorised rollers 11 that engage with one or two faces of the individual substrate pieces. Also, support roller 3 may be motorised to drive the extrusion 1 below hopper 2. In an

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automated embodiment of the apparatus the motorised rollers 11 and 3 may be operated from a variable speed motor drive which may interface with a controller.

The hopper section 10 comprises the hopper 2, preferably with steep sides to avoid  
5 build-up of product, that might hold typically, but not exclusively, 1-1.5 kg of dry powder formulation. The hopper 2 shown in Figure 1 is cut-away for illustration purposes.

An adjustable mounting bracket 4 may also be included to enable the hopper 2 to be  
10 located in the correct position so that a bottom orifice 5 lines up with the channels or depressions 6 in the extrusion 1. Orifice 5 may be formed in a die 9, which is adapted to suit the extrusion 1 being used. The die 9 would butt snugly over extrusion 1 so that no formula was spilled or wasted. Various dies may be interchangeable to provide for different substrates. The dies may have more than  
15 orifice - for example a two orifice die for a two channel or depression substrate.

There is a compressible foam rubber insert 7 between the hopper body 1 and the  
bottom orifice 5, which suspends the bottom orifice 5 in such a way that it will still seal against the extrusion 1 even if the extrusion 1 is not perfectly lined up with the  
20 hopper 2.

A support roller 3 mounted directly beneath the bottom orifice 5 of the hopper 2 to support the extrusion 1 without imposing excessive friction. This allows the extrusions 1 to be readily moved through the system. Roller 3 may be motorised but



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this is not essential as its main function is to hold the extrusion up to the orifice 5. A bristle brush (not shown) may be mounted directly below the roller 3, with its bristles in contact with the roller, so that any powder that falls onto the roller is subsequently brushed off and will not to build up on the roller 3.

5

A mechanism (not shown) for tapping the hopper 2 at regular intervals can be provided so that any "rat-holes" in the dry power are re-filled. Typically the tapping action will occur once every 30-60 seconds of operation, which is not enough to allow the different components of the dry powder formulation to separate  
10 substantially. In its simplest form this "mechanism" may in fact be the hand of a human operator, but ideally this function is carried out by a solenoid or air actuated arm. Alternatively an auger or screw may be included which either continuously or intermittently "mixes" the formula, thereby filling any "rat holes".

15 The apparatus also includes a heat-curing system, for example an oven, 12 to provide enough heat to melt and cure the dry powder formulation, and bond it to the substrate. This could be an oven with a rack system. After the individual substrate pieces have had their channels or depressions filled with the dry powder formulation they are loaded by hand onto the racks. When the racks are full the racks are placed  
20 in the oven for the required time. Using this system a typical curing cycle may be 10-20 minutes at 160°C to 200°C.

In an automated apparatus the oven would most preferably be a continuous tunnel process so that after the individual substrate pieces have had their channels or



A representative piece of substrate is placed on the guide rail close to the empty hopper, then passed into the gap between the bottom orifice of the hopper and the support roller. The position of the hopper assembly is adjusted as necessary to ensure that the bottom orifice lines up with the channels or depressions in the substrate, and there are no gaps to either side that would let powder escape. The hopper is then filled with a thoroughly mixed quantity of the dry powder formulation.

The first piece of "production" substrate is then placed on the guide rail, immediately behind the representative piece of substrate, and moved towards the hopper assembly. In this way it pushes the representative piece of substrate through and passed the hopper assembly and onto the guide rail on the other side of the hopper assembly. The representative piece of substrate can subsequently have the powder that has been applied to it removed by a vacuum cleaning head and then the substrate can be reused as a plug for the hopper's bottom orifice whenever production is halted.

Before the first piece of production substrate is pushed right through the hopper assembly the second piece of production substrate is picked up off a magazine and placed on the guide rail immediately behind the first piece of production substrate. Once the first piece of production substrate is away from the hopper assembly it can be taken off the guide rail and placed on racks ready for oven curing.

The above step is then repeated until the oven racks are full. The racks are placed in the oven for the required curing cycle, then removed from the oven and allowed to cool before final inspection and packaging.

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At regular intervals as required the hopper is tapped to remove "rat-holes" in the powder and the hopper is refilled with thoroughly mixed dry powder formulation.

- 5 When the production run has finished the representative piece of substrate can be reused as a plug for the hopper's bottom orifice and finally any left-over powder can be removed from the hopper.

10 It can readily be seen that whereas the above description describes the method of operation for a non-mechanised form of the apparatus the process can readily be automated using the optional automating equipment described above so that the process becomes either semi-automatic or fully automatic. Such automation would be well within the capabilities of the nominally skilled person.

- 15 Photo-luminescent formulation can be applied, by the above-described method, to articles having channelled surfaces for use in such places as picture theatres, sporting arenas, aircraft aisles and building corridors/stairways where the illumination can be adapted in guiding people to an exit in an emergency or when normal lighting fails. Two examples of articles are step nosings and handrails.

20

A step nosing is the angled member across the front edge of a step. The current invention can be used to deposit photo-luminescent formulation within castellations, or recessed channels, in the top surface of a step nosing. This results in a step nosing which is luminescent for an extended period after ambient illumination is

- 15 -

switched off, and hence helps maintain the safety of spectator areas in picture theatres, sporting arenas and the like in low light situations. The extrusion 1 illustrated in Figure 1 is a step nosing with castellations, or recessed channels, 6 in its top surface.

5

In a further embodiment the photo-luminescent formulation might be deposited within castellations, or recessed channels, of a insert strip which engages with the top surface of a step nosing. This would allow the photo-luminescent insert strip to be replaced without replacing the whole step nosing.

10

Photo-luminescent formulation could also be deposit within castellations, or recessed channels, on stair and other handrails. The castellations, or recessed channels, carrying the photo-luminescent formulation may be part of a replaceable insert strip.

15

Where in the foregoing description reference has been made to integers or elements having known equivalents, then such equivalents are herein included as if individually set forth.

20

Particular examples of the invention have been described and it is envisaged that improvements and modifications can take place without departing from the scope of the appended claims.

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# CLAIMS

1. A method of applying photo-luminescent pigment to a substrate, said method including:

5                    preparing a dry powder formulation comprising, at least, a photo-luminescent pigment and a carrier/fixer;

                     depositing the dry powder formulation onto a substrate surface; and,

                     heating the dry powder formulation to fuse it to the substrate surface.

- 10    2. A method as claimed in any preceding claim wherein the substrate surface has depressions or channels adapted to receive the dry powder formulation.

3. A method as claimed in claim 2 which further includes applying a light reflecting layer to the substrate surface before depositing the dry powder formulation.

15

4. A method as claimed in any one of claims 1 to 3 wherein the volume ratio of photo-luminescent pigment to carrier/fixer in the dry powder formulation is such that the fused material exhibits substantially the same strength and durability properties of the carrier/fixer while still exhibiting the photo-luminescent properties of the pigment.

20

5. A method as claimed in claim 4 wherein the volume ratio is substantially in the range of 1% to 35% photo-luminescent pigment to carrier/fixer.

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6. A method as claimed in any preceding claim wherein the dry powered formulation is heated to a temperature recommended by the manufacturer of the carrier/fixer until the formulation is molten.
- 5 7. A method as claimed in claim 6 wherein the formulation is heated to substantially between 160 to 210 degrees centigrade.
8. A method as claimed in claim 6 or claim 7 wherein the formulation is heated  
10 for approximately 10 to 20 minutes.
9. A method as claimed in any preceding claim wherein after heating the formulation is cooled.
- 15 10. A method as claimed in any preceding claim wherein the carrier/fixer is a heat curable polymer.
11. A method as claimed in any preceding claim wherein the dry powder formulation includes small quantities of additives, such as a de-gassing  
20 additive, to ensure a smooth surface finish.
12. A method as claimed in any preceding claim wherein the substrate is stamped, extruded or milled aluminium or metal.

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13. An apparatus for applying photo-luminescent pigment to a substrate, said apparatus including:

a hopper adapted to contain a dry powder formulation;

one or more orifices adapted to allow transfer of the dry powder formulation from the hopper to a substrate surface;

a guide rail system for locating the substrate surface in both a fixed horizontal plane and a fixed vertical plane below the hopper and orifice; and a heat-curing system for providing enough heat to turn the dry powder formulation into a molten mix.

14. An apparatus as claimed in claim 13 which also includes a cooling system to cool the molten mix.

15. An apparatus as claimed in any one of claims 13 or 14 which also includes a drive system to move the substrate through the apparatus.

16. An apparatus as claimed in any one of claims 13 to 15 which includes a support roller mounted directly beneath the orifice(s) and hopper to support the substrate.

17. An apparatus as claimed in any one of claims 13 to 16 which includes an adjustable mounting bracket adapted to enable the hopper to be located in the correct position so that the orifice(s) lines up with the substrate.



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18. An apparatus as claimed in any one of claims 13 to 17 wherein the orifice is adapted to communicate snugly with the substrate surface such that the dry powder formulation is deposited substantially only where required.
- 5 19. An apparatus as claimed in any one of claims 13 to 18 which includes a mechanism for tapping the hopper so that any rat-holes in the dry powder formulation are re-filled.
- 20 An apparatus as claimed in any one of claims 13 to 19 which includes a brush  
10 mounted below the roller, and with its bristles in contact with the roller, so that any powder that falls onto the roller is subsequently brushed off.
21. An apparatus as claimed in any one of claims 13 to 20 wherein the heat-curing system is an oven.
- 15 22. An apparatus as claimed in any one of claims 13 to 21 wherein the heat-curing system is a continuous oven process.
23. An apparatus as claimed in claim 22 wherein the oven includes infra-red  
20 heating elements.
24. An apparatus as claimed in any one of claims 13 to 23 which includes an automatic loading and unloading means at each end.

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25. A method of applying photo-luminescent pigment to a substrate as herein described with reference to the examples.
26. An apparatus for applying photo-luminescent pigment to a substrate as herein  
5 described with reference to the accompanying drawings.
27. A substrate bearing photo luminescent material when prepared using a method according to any one of claims 1 to 12 and 25.
- 10 28. A substrate bearing photo luminescent material when prepared using an apparatus according to any one of claims 13 to 24 and 26.
29. A step nosing, or insert strip for a step nosing, bearing photo luminescent material when prepared using a method according to any one of claims 1 to  
15 12 and 25.
30. A step nosing, or insert strip for a step nosing, bearing photo luminescent material when prepared using an apparatus according to any one of claims 13 to 24 and 26.
- 20 31. A handrail, or insert strip for a handrail, bearing photo luminescent material when prepared using a method according to any one of claims 1 to 12 and 25.

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32. A handrail, or insert strip for a handrail, bearing photo luminescent material when prepared using an apparatus according to any one of claims 13 to 24 and 26.

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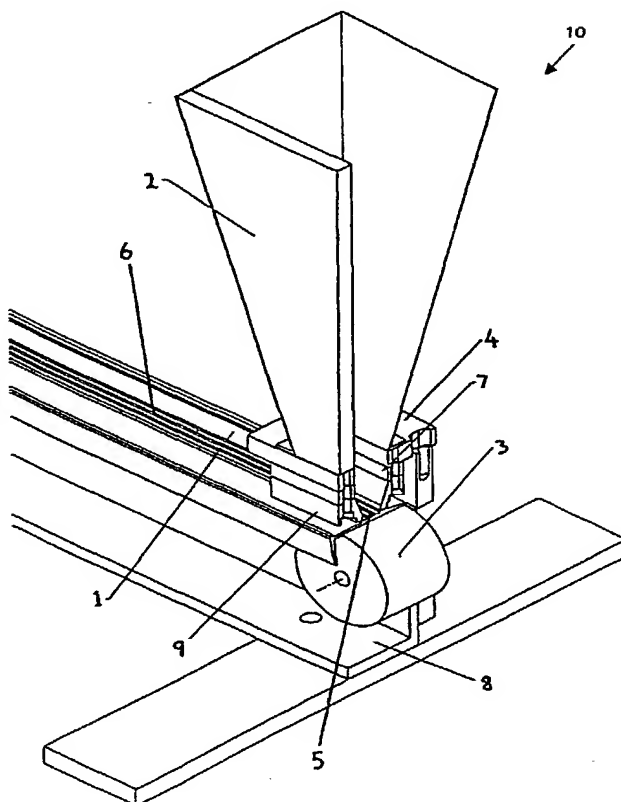
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[Continued on next page]

(54) Title: **PHOTO-LUMINESCENT PIGMENT APPLICATION**



(57) Abstract: A method of applying photo-luminescent pigment to a substrate, such as an aluminium or metal strip containing channels or depressions, includes preparing a dry powder formulation comprising a photo-luminescent pigment and a carrier/fixer, depositing the dry powder formulation onto the substrate surface, and heating to fuse the dry powder formulation to the substrate surface. The photo-luminescent pigment can be applied using an apparatus which includes a hopper adapted to contain the dry powder formulation, one or more orifices adapted to allow transfer of the dry powder formulation from the hopper to a substrate surface and a guide rail system for locating the substrate surface in both a fixed horizontal plane and a fixed vertical plane below the hopper and orifice.

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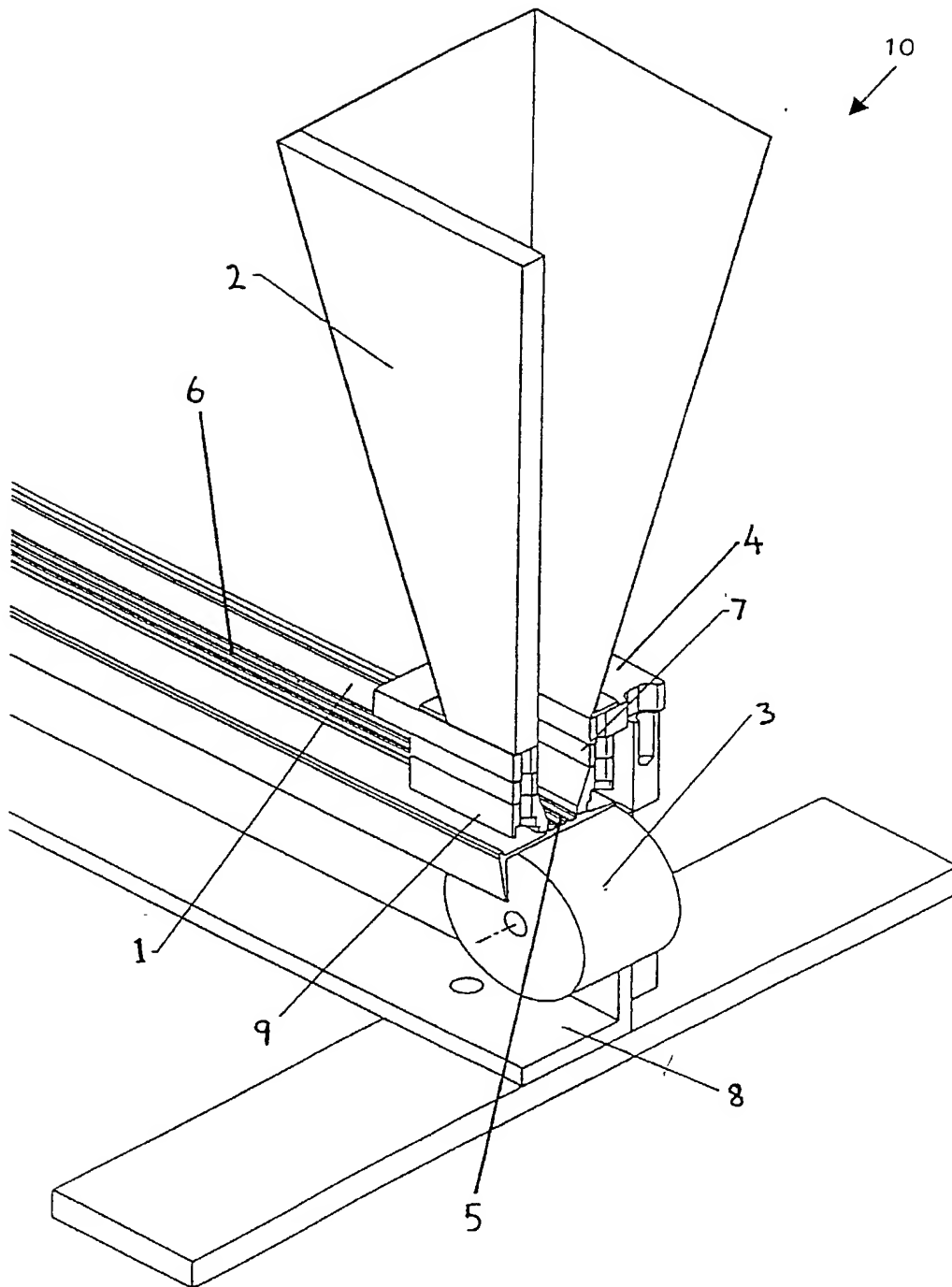


FIGURE 1

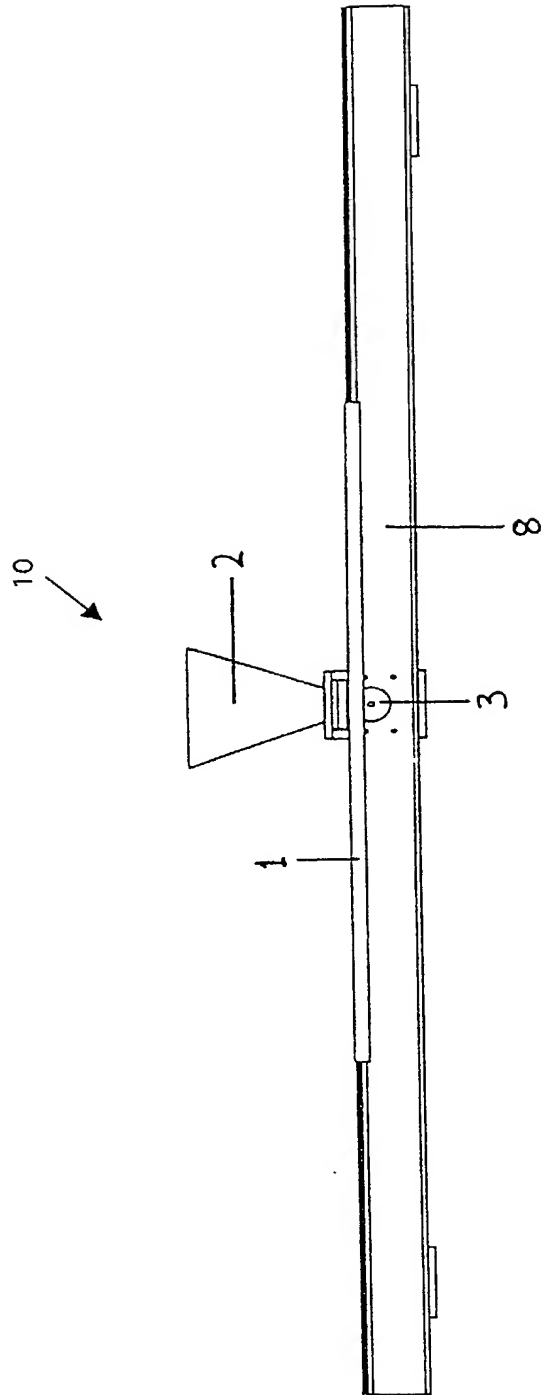


FIGURE 2

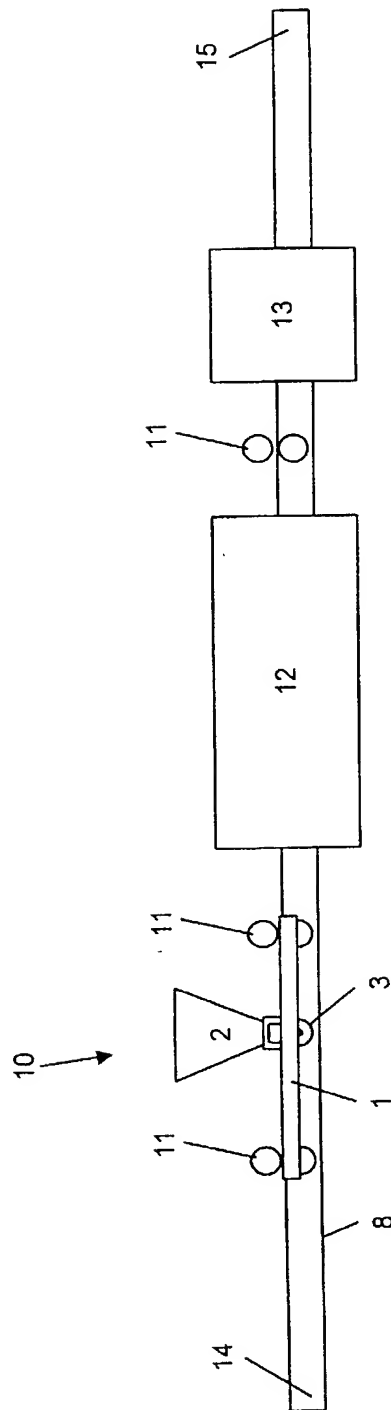


FIGURE 3

ATTORNEY'S DOCKET NO. BSW-1

PCT/USA NATIONAL DECLARATION AND POWER OF ATTORNEY  
FOR U.S. PATENT APPLICATIONS  
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
UNDER 35 U.S.C. SECTION 371(c)(4)

As a below named inventor, we hereby declare that:

Our residence, post office address and citizenship are as stated below next to my name:

I verily believe I am the original, first and sole inventor (if only one name is listed below) or a joint inventor (if plural inventors are named below) of the invention described and claimed in international application No. PCT/NZ00/00127 entitled: PHOTO-LUMINESCENT PIGMENT APPLICATION and as amended on \_\_\_\_\_ (if any), which I have reviewed, and I understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above and for which I solicit a patent; that I do not know and do not believe that this invention was ever known or used in the United States of America before my or our invention or discovery thereof, or patented or described in any printed publication in any country before my or our invention or discovery thereof, or more than one year prior to my international application; that this invention was not in public use or on sale in the United States of America for more than one year prior to my international application; that this invention has not been patented or made the subject of an inventor's certificate issued before the date of my international application in any country foreign to the United States; of America on an application filed by me or my legal representatives or assigns more than twelve months before my international application; that I acknowledge my duty to disclose information of which I am aware which is material to the examination of this application; and that prior to filing said international application, applications for patent or inventor's certificate on this invention of discovery which have been filed by me or my legal representatives or assigns in any country foreign to the United States of America are as follows:

(a) none filed more than 12 months prior to said international application, unless named below:

(b) earliest filed less than 12 months prior to said international application (the priority of which is hereby claimed under 35 U.S.C. Section 365):

New Zealand Application No. 336795 filed July 16, 1999

I hereby claim the benefit under Title 35, United States Code, §120, of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a), which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

(Application Serial No.)

(Filing Date)

(Status)(patented, pending, abandoned)

I hereby appoint Randall J. Knuth, Regis. No. 34,644, Victor F. Lohmann, III, Regis. No. 33,951 and Vincent P. Merz, Jr., Regis. No. 45,722 of the firm of RANDALL J. KNUTH, P.C., as attorney(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

I declare further that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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200  
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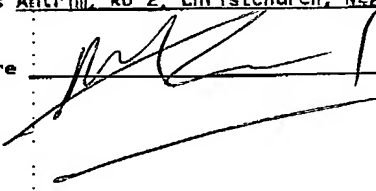
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